FUTURE FISHERIES IMPROVEMENT PROGRAM
GRANT APPLICATION
(please fill in the highlighted areas)

I. APPLICANT INFORMATION

A. Applicant Name: Montana Fish, Wildlife & Parks

B. Mailing Address: 1354 Highway 10 West

C. City: Livingston State: MT Zip: 59047

Telephone: 406 222-3710

D. Contact Person: Carol Endicott

Address if different from Applicant:

City: State: Zip:

Telephone:

E. Landowner and/or Lessee Name (if other than Applicant): Gallatin National Forest (contact Clint Sestrich)

Mailing Address: 5242 Highway 89 South

City: Livingston State: MT Zip: 59047

Telephone: 823-6067

II. PROJECT INFORMATION*

A. Project Name: Crandall Creek Barrier

River, stream, or lake: Shields River

Location: Township 5N Range 11E Section 18

County: Meagher County

B. Purpose of Project:

The purpose of this project is to secure a population of nonhybridized Yellowstone cutthroat trout that is at risk of displacement by nonnative brook trout.

C. Brief Project Description:

The Shields River watershed is one of the few basin-level strongholds for Yellowstone cutthroat trout remaining with mostly nonhybridized fish distributed throughout the watershed. Nonnative brook trout present a considerable threat to the persistence of Yellowstone cutthroat trout, especially in headwaters streams. Extensive survey and study of movements of fishes indicate brook trout are undergoing a current and rapid invasion of streams in the upper Shields River watershed, combined with displacement of Yellowstone cutthroat trout. Without intervention, we will likely lose this population of Yellowstone cutthroat trout within a few decades.

The neighboring Smith Creek watershed illustrates the ability of brook trout to displace Yellowstone cutthroat trout. In the early 1970s, brook trout were rare, whereas Yellowstone cutthroat trout were abundant throughout the watershed. By the early 2000s, where Yellowstone cutthroat trout were still present, brook trout outnumbered them tenfold. Brook trout have apparently extirpated Yellowstone cutthroat trout from several tributaries.

This project is part of a larger, collaborative effort to secure and study this population of Yellowstone cutthroat trout. Partners include Montana Wildlife & Parks (FWP), the Gallatin National Forest (GNF), and the Wildlife Conservation Society (WCS). An extensive sampling effort in 2009 found brook trout had invaded streams where they had been absent just years before. The WCS (Shepard 2013) has been studying the movement of Yellowstone cutthroat trout and brook using passive integrated transponder (PIT) tag technology. In general, brook trout move farther than Yellowstone cutthroat trout, which likely accounts for their success at invading new habitat.

This application is a request for funds to construct a barrier within the upper Shields River watershed. In the interim, project partners will be removing brook trout from tributaries using electrofishing. Temporary barriers placed within these streams will prevent reinvasion of brook trout. Likewise, following successful removal of brook trout, the tributaries will provide holding waters for salvaged Yellowstone cutthroat trout. Following an aggressive salvage effort, we will use piscicide to remove fish downstream of the temporarily secured tributaries. The salvaged fish would be returned to the reclaimed waters.

As maintaining connectivity within the watershed is a conservation priority, the barrier design allows for removal of the impassable elements. This design gives us the flexibility to move downstream with Yellowstone cutthroat trout conservation efforts should these opportunities arise.

D. Length of stream or size of lake that will be treated:

The culvert will be 30 feet long by 25 feet wide and will protect 25 miles of stream for Yellowstone cutthroat trout.

E. Project Budget:

Grant Request (Dollars): **$ 129,775**

Contribution by Applicant (Dollars): $ _____ In-kind $ _____
(salaries of government employees are not considered as matching contributions)

Contribution from other Sources (Dollars): $ 275,450 In-kind $ _____
(attach verification - See page 2 budget template)

Total Project Cost: **$ 405,225**

F. Attach itemized (line item) budget – see template

See Attachment A

G. Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

See Attachment B

H. Attach land management and maintenance plans that will ensure protection of the reclaimed area.

III. PROJECT BENEFITS*

A. What species of fish will benefit from this project?

Yellowstone cutthroat trout is the species that will benefit from this project.

B. How will the project protect or enhance wild fish habitat?

This project will protect a population of nonhybridized Yellowstone cutthroat trout from displacement by brook trout.

C. Will the project improve fish populations and/or fishing? To what extent?

This project will secure angling opportunities for native Yellowstone cutthroat trout within the Shields River watershed. Given the marked reductions in distribution and abundance of native cutthroat trout in Montana, conservation of Yellowstone cutthroat trout within the project area will provide considerable benefit to anglers targeting native species.

D. Will the project increase public fishing opportunity for wild fish and, if so, how?

The area upstream of the proposed barrier is within the Gallatin National Forest, so anglers have access to the entire area.

E. If the project requires maintenance, what is your time commitment to this project?

The barrier will need occasional maintenance to remove trees and other debris. The Gallatin National Forest will be responsible for this maintenance as part of their regular road maintenance operations.

F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?

The habitat within the watershed upstream of the proposed barrier is in excellent condition. The GNF has recently constructed road improvements that will decrease sediment delivered from roads and provide passage for aquatic organisms. This part of the watershed was logged decades ago and has recovered, showing no indication of increased water yield or bed load supply. The crossing is adjacent to a campground, which receives pressure from humans, horses, and cattle; however, this is a small, isolated area of disturbance.

G. What public benefits will be realized from this project?:

Without intervention, brook trout will likely displace Yellowstone cutthroat trout within a few decades, as they have in the Smith Creek watershed. This loss would increase justification for including Yellowstone cutthroat trout for protection under the Endangered Species Act. This loss would have negative consequences for Montana's agricultural, silvicultural and other natural resource based industries that could potentially lose flexibility in their operations. Likewise, Montanans benefit with conservation of this component of their natural heritage.

H. Will the project interfere with water or property rights of adjacent landowners? (explain):

No.

I. Will the project result in the development of commercial recreational use on the site?: (explain):

No.

J. Is this project associated with the reclamation of past mining activity?:

No.

Each approved project sponsor must enter into a written agreement with the Department specifying terms and duration of the project.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature: _____ Date: _____

Sponsor (if applicable):

***Highlighted boxes will automatically expand.**

Mail To: **Montana Fish, Wildlife & Parks**
Habitat Protection Bureau
PO Box 200701
Helena, MT 59620-0701

Incomplete or late applications will be returned to applicant.

Applications may be rejected if this form is modified.

*****Applications may be submitted at anytime, but must be received by the Future Fisheries Program office in Helena before December 1 and June 1 of each year to be considered for the subsequent funding period.*****

Attachment A: Budget

WORK ITEMS (ITEMIZE BY CATEGORY)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	CONTRIBUTIONS			
					FISHERIES REQUEST	IN-KIND SERVICES	IN-KIND CASH	TOTAL
Personnel	1	Lump Sum	$ 13,150.00	$ 13,150.00			$ 13,150.00	$ 13,150.00
Survey, design, engineering, & permitting	1	Lump Sum	$ 32,300.00	$ 32,300.00			$ 32,300.00	$ 32,300.00
Fish Barrier Construction								
MOBILIZATION	1	Lump Sum	$ 37,000.00	$ 37,000.00			$ 37,000.00	$ 37,000.00
CONSTRUCTION SURVEY AND STAKING	1	Lump Sum	$ 7,500.00	$ 7,500.00	$ 7,500.00			$ 7,500.00
SOIL EROSION & POLLUTION CONTROL	1	Lump Sum	$ 2,000.00	$ 2,000.00	$ 2,000.00			$ 2,000.00
DEWATERING	1	Lump Sum	$ 5,000.00	$ 5,000.00			$ 5,000.00	$ 5,000.00
REMOVAL OF EXISTING BRIDGE	1	Each	$ 15,000.00	$ 15,000.00			$ 15,000.00	$ 15,000.00
UNCLASSIFIED BORROW (GOVERNMENT FURNISHED)	2300	Cubic Yard	$ 5.00	$ 11,500.00			$ 11,500.00	$ 11,500.00
STRUCTURE EXCAVATION	1	Lump Sum	$ 10,000.00	$ 10,000.00			$ 10,000.00	$ 10,000.00
PLACED RIPRAP, CLASS 5, MACHINE PLACED (GOVERNMENT FURNISHED)	300	Cubic Yard	$ 60.00	$ 18,000.00			$ 18,000.00	$ 18,000.00
GEOCELL ABUTMENT STABILIZATION	45	Square Yard	$ 125.00	$ 5,625.00	$ 5,625.00			$ 5,625.00
CRUSHED AGGREGATE, SURFACING (GOVERNMENT FURNISHED)	110	Cubic Yard	$ 60.00	$ 6,600.00	$ 6,600.00			$ 6,600.00
STRUCTURAL CONCRETE, CLASS A(AE)	32	Cubic Yard	$ 900.00	$ 28,800.00			$ 28,800.00	$ 28,800.00
PRECAST CONCRETE MEMBER, BRIDGE	20	Linear Foot	$ 4,000.00	$ 80,000.00			$ 80,000.00	$ 80,000.00
PRECAST CONCRETE MEMBER, FOOTING	42	Linear Foot	$ 650.00	$ 27,300.00	$ 27,300.00			$ 27,300.00
PRECAST CONCRETE MEMBER, WINGWALL	4	Each	$ 20,000.00	$ 80,000.00	$ 80,000.00			$ 80,000.00
REINFORCING STEEL	4500	Pound	$ 2.00	$ 9,000.00			$ 9,000.00	$ 9,000.00
35"x24" CORRUGATED STEEL PIPE-ARCH, 0.064" THICK	136	Linear Foot	$ 100.00	$ 13,600.00			$ 13,600.00	$ 13,600.00
EQUIPMENT RENTAL, HYDRAULIC EXCAVATOR	8	Hour	$ 145.00	$ 1,160.00			$ 1,160.00	$ 1,160.00
EQUIPMENT RENTAL, LARGE DUMP TRUCK	8	Hour	$ 55.00	$ 440.00			$ 440.00	$ 440.00
SEEDING, DRY METHOD (GOV'T FURNISHED SEED)	1	Lump Sum	$ 500.00	$ 500.00	$ 500.00			$ 500.00
MULCHING, DRY METHOD	1	Lump Sum	$ 750.00	$ 750.00	$ 250.00		$ 500.00	$ 750.00
								$ -
								$ -
			TOTALS	$ 405,225.00	$ 129,775.00	$ -	$ 275,450.00	$ 405,225.00

Revised August 5, 2009

*Units = feet, hours, inches, lump sum, etc.

MATCHING CONTRIBUTIONS

CONTRIBUTOR	IN-KIND SERVICE	IN-KIND CASH	TOTAL
Gallatin National Forest	$ -	$ 95,450.00	$ 95,450.00
Bring Back the Natives	$ -	$ 80,000.00	$ 80,000.00
WNTI	$ -	$ 50,000.00	$ 50,000.00
One Fly Partnership	$ -	$ 30,000.00	$ 50,000.00
	$ -	$ -	$ -
	$ -	$ -	$ -
	$ -	$ -	$ -
	$ -	$ -	$ -
	$ -	$ -	$ -
Total	$ -	$ -	$ 275,450.00

Attachment B

Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support, and/or information necessary to evaluate the merits of the project. If the project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

The Shields River watershed (Figure 1) is a basin-level stronghold for nonhybridized to slightly hybridized Yellowstone cutthroat trout. This native species occupies 66% of its historic habitat in the basin's streams. This relatively wide distribution is the greatest remaining extent of Yellowstone cutthroat trout in all subbasins[1] occurring mostly in Montana (Table 1). Although nonhybridized Yellowstone cutthroat trout occupy a majority of the historically held streams, they face several threats including hybridization with rainbow trout, habitat degradation, warm stream temperatures, and competition with brown trout. In headwater streams, brook trout are a primary concern, as this nonnative species is highly competitive and can displace Yellowstone cutthroat trout populations within a few decades.

This portion of the watershed has been a high priority for the Gallatin National Forest in terms of conserving native fish and improving water quality. The Gallatin National Forest has invested approximately $6 million in road and road crossing improvements. These improvements will substantially decrease sediment loading from forest roads. Moreover, the road crossings in the project area are either bridges or bottomless arch pipes that provide passage for aquatic organisms. The intent is to provide a connected stream network with reduced levels of fine sediment.

[1] Subbasins correspond to 4th code hydrologic units or HUCs.

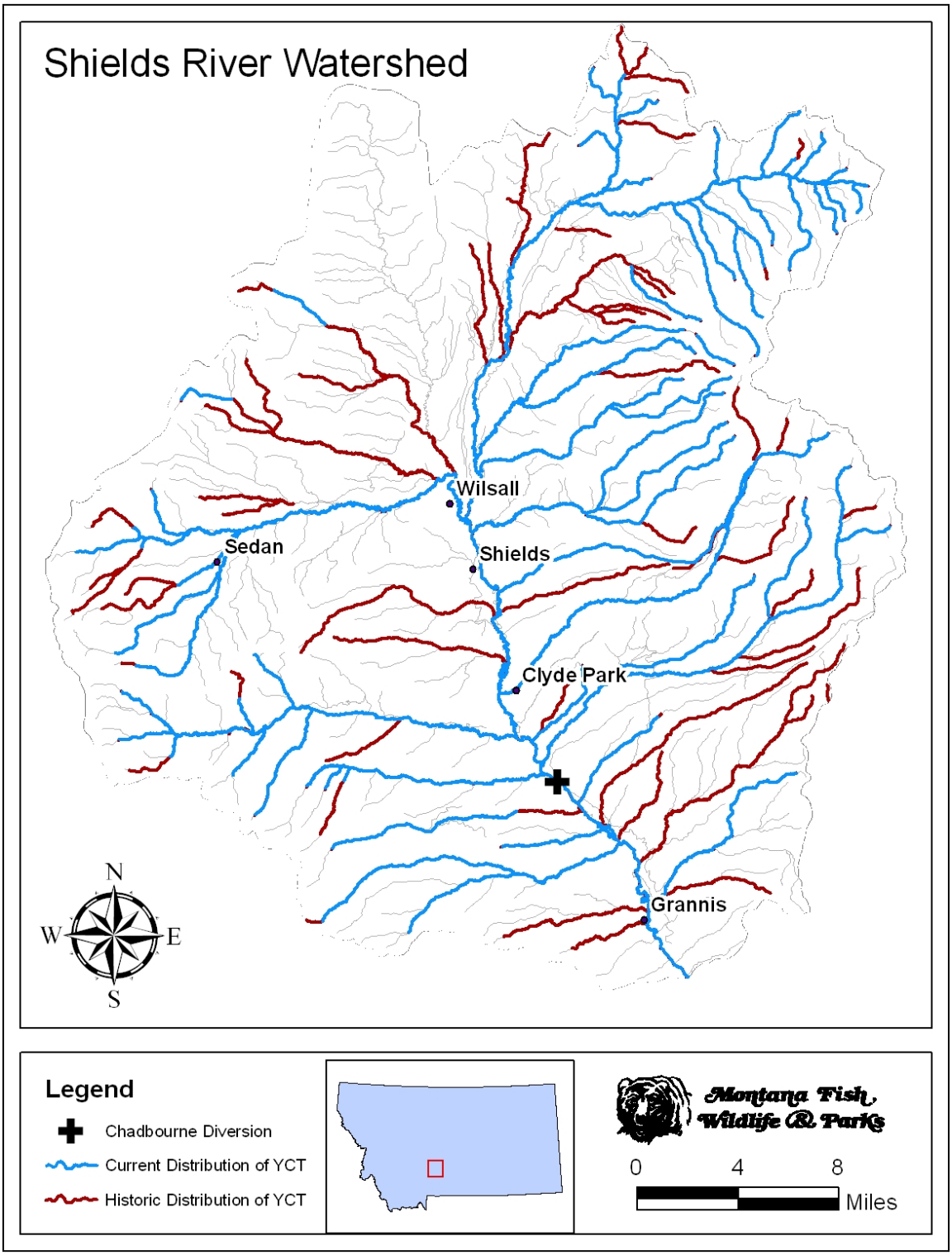

Figure 1: Shields River watershed, showing historic and current distribution of Yellowstone cutthroat trout.

Table 1: Comparison of historic and current occupied stream miles for 4th level hydrologic units with substantial stream miles in Montana (from May et al. 2007).

Name	*HUC*	*Historically Occupied Miles*	*Currently Occupied Miles*	*Percent of Miles Still Occupied*
Upper Yellowstone	10070002	1,116	560	50%
Shields	**10070003**	**682**	**453**	**66%**
Upper Yellowstone-Lake Basin	10070004	288		0%
Stillwater	10070005	416	103	25%
Clarks Fork Yellowstone	10070006	525	81	15%
Upper Yellowstone-Pompey's Pillar	10070007	273		0%
Pryor	10070008	226	27	12%
Big Horn Lake	10080010	278	65	23%
Shoshone	10080014	172	4	2%
Lower Bighorn	10080015	422	7	2%
Little Bighorn	10080016	224	20	9%

Several planning and prioritization efforts provide justification to rank this as critical area for cutthroat conservation. The statewide conservation agreement for cutthroat trout (MCTSC 2007) places securing nonhybridized populations as the highest conservation priority. Extensive genetic sampling in the project area has found no indication of hybridization (Kalinowski 2010a; Kalinowski 2010b) in these Yellowstone cutthroat trout, which affords them the greatest protection possible.

The conservation strategy for the Shields River watershed (Endicott et al. 2012) also places this project as a high priority. Development of this strategy was a requirement of the statewide conservation agreement and it provides a means to make informed decisions on conservation needs and their prioritization. The strategy summarizes the available information on species composition, genetic status, habitat condition, temporal trends, and longitudinal trends. Temporal and longitudinal trends from the early 1970s to 2009 indicate steady, upstream expansion of brook trout with a concomitant reduction in Yellowstone cutthroat trout numbers. Moreover, this expansion has accelerated in recent years with climate being a potential contributor to this faster rate of invasion (Shepard 2013). The combination of the rapid rate of invasion and displacement puts this population at extreme risk of extirpation.

The approach to conserving this core population of Yellowstone cutthroat trout will entail several components. This grant application addresses the construction of a barrier at a road crossing just upstream of the boundary of the Gallatin National Forest (Figure 2). This placement will protect about 25 miles of stream habitat from reinvasion of brook trout.

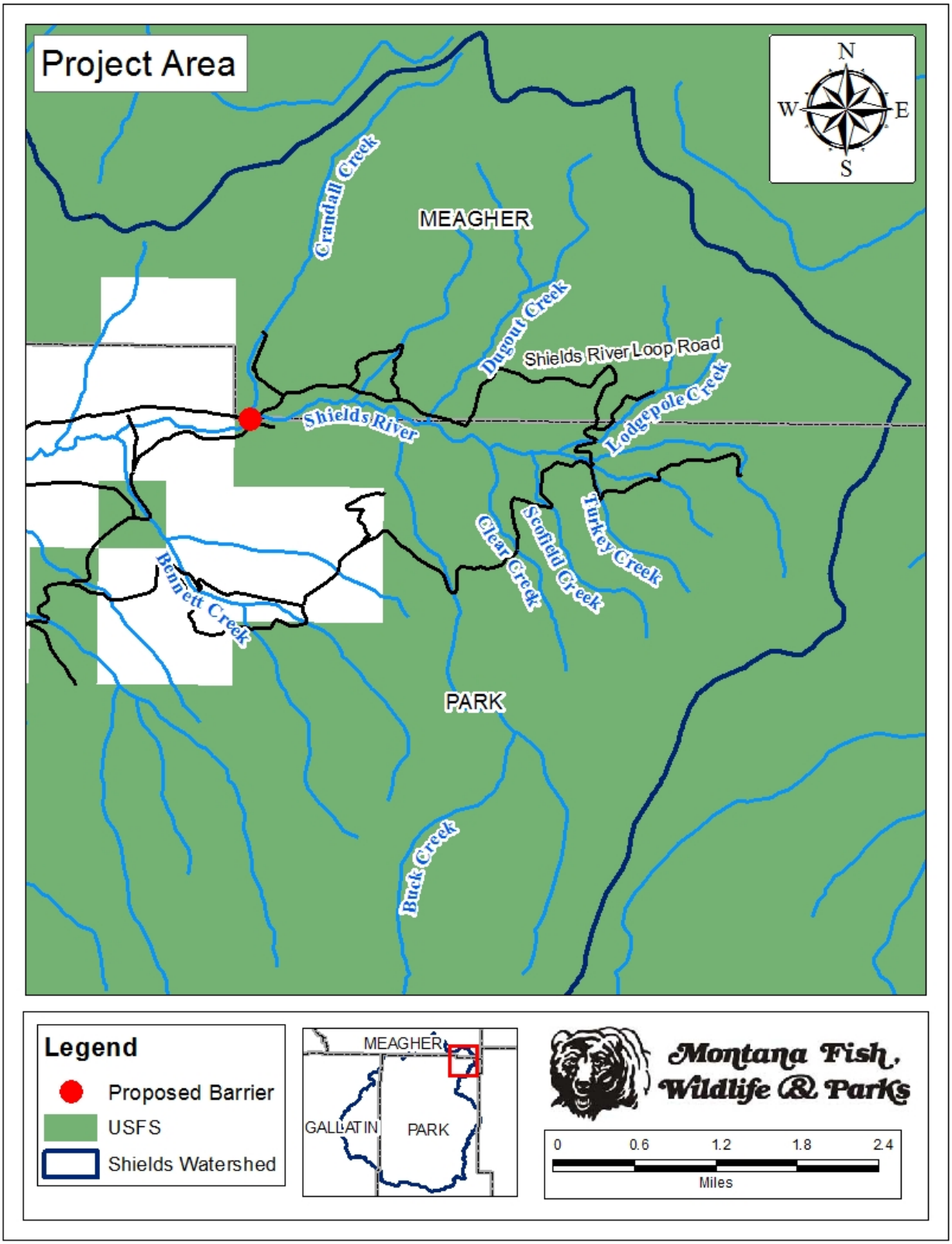

Figure 2: Map of project area

In the interim, project partners will be mechanically removing brook trout from several tributaries located upstream of the proposed barrier. Temporary barriers in the form of perched culverts already installed in these tributaries will prevent reinvasion of brook trout. After the proposed barrier is in place and brook trout are absent from tributaries, the project partners will launch a massive Yellowstone cutthroat trout salvage effort and hold these fish in live cars placed in the tributaries. Once the cutthroat trout are secured, we will use rotenone to remove fish from waters still supporting brook trout. This piscicide has extremely low toxicity to organisms lacking gills and breaks down rapidly in the environment. Establishment of a detoxification station immediately downstream of the new barrier will limit the spatial extent of treated waters. The salvaged fish will be returned to reclaimed waters when sentinel fish indicate stream waters are no longer toxic. We used this approach in Lower Deer Creek and we returned the salvaged fish within 24 hours of the cessation of rotenone treatment. Following removal of brook trout, the Gallatin National Forest will remove the perched culverts and install arched pipes that will allow passage of fish and other organisms.

This project may provide an opportunity to use an innovative and developing technology to determine whether brook trout removal was successful. Environmental DNA (e-DNA) refers to DNA detectable in streams or lakes that signals the presence of a given species of fish. This technology is being used to track presence of Asian carp in the Illinois River and their potential to invade Lake Michigan. Researchers are developing e-DNA markers to detect the presence of brook trout, among other species. As absence is difficult to prove through electrofishing, e-DNA may provide a cost-effective approach to determining species presence that requires only a water sample, not numerous field crews traversing rough and remote country. Geneticists project they will have developed and calibrated this technology for brook trout by the time the piscicide portion of the project will begin.

Barrier construction presents an apparent paradox with other conservation priorities for cutthroat trout. Among these priorities are maintaining connectivity to allow for gene flow, protecting migratory life history strategies, and allowing for recolonization after catastrophic events. The conservation strategy for the Shields River watershed (Endicott et al. 2012) stresses connectivity for the reasons above, and promotes a metapopulation approach that allows interaction among spatially separated populations. Barrier construction is counterintuitive to these conservation priorities, as barriers block movement. Conversely, the strategy recognizes that barriers may be necessary in some cases to protect metapopulations that are at high risk of extirpation.

This Yellowstone cutthroat trout population meets criteria as an imperiled population. The rate of brook trout expansion and their ability to displace Yellowstone cutthroat trout within a short period of sympatry means we will likely lose this metapopulation in the near future without intervention. The cutthroat trout strategy (Endicott et al. 2013) documents the rapid rate of invasion and displacement from the early 1970s through 2009. Moreover, recent research in the upper Shields River watershed (Shepard 2013) has documented continued invasion and increase

in brook trout numbers. In addition, investigation of movements of fishes indicates brook trout move farther than Yellowstone cutthroat trout, which could account for their invasive tendencies.

Although a barrier is contrary to maintaining connectivity among metapopulations, this project may be compatible with maintaining connectivity over the long-term. The barrier design allows it to be removed. Removing the barrier would provide the opportunity to work downstream to increase the amount of habitat available for Yellowstone cutthroat trout without the presence of brook trout should these opportunities arise.

Another consideration in installing this barrier is its potential to prevent upstream migration of main stem fish into the headwaters to spawn. Protection of this fluvial life-history strategy is a high conservation priority; nonetheless, considerable uncertainty exists on whether fluvial Yellowstone cutthroat trout migrate into the project area. One limitation in understanding movements of fluvial fish is their rarity. Yellowstone cutthroat trout are tagged during yearly monitoring efforts in the main stem, and over the past decade, the number of Yellowstone cutthroat trout captured during spring sampling has ranged from 0 to 7 fish. Although FWP has not received any reports of tagged fish in the upper Shields River watershed, the low number of tagged fish in the river does not allow for much inference on movements of main stem fish.

Results of intensive sampling in the upper Shields River watershed (Shepard 2013) does not provide evidence that fluvial fish migrate into the project area. Spatially extensive electrofishing during the spawning period did not yield any apparent fluvial fish. Monitoring the movement of PIT tagged Yellowstone cutthroat trout found most were resident, although some upper watershed residents moved into tributaries to spawn.

The proposed barrier location (Figure 2) is at an existing road crossing, where the Shields River Loop Road crosses the Shields River. The site is within the GNF boundary and just downstream from Crandall Creek. Tributaries upstream of the barrier include Crandall Creek, Dugout Creek, upper Lodgepole Creek, Turkey Creek, Scofield Creek, Clear Creek, Buck Creek, and several unnamed tributaries.

Ideal sites for barrier construction are canyon reaches with lateral, bedrock wall confinement. This site abuts a steep wall of shale on the right bank; however, the left bank has access to a wide floodplain, which is the site of a U.S. Forest Service campground. To prevent flood flows from bypassing the culvert, the designs call for construction of a berm that will extend about 130 feet from the road crossing across the floodplain. Bypass pipes installed within the berm allow for drainage during flows exceeding bank-full.

The Gallatin National Forest commissioned preliminary designs (see attached design sheets), which may change with additional survey and review. Nevertheless, they provide sufficient detail to develop a preliminary cost estimate that will guide grant acquisition efforts. The proposed barrier will be a pre-cast box culvert placed under a bridge crossing the Shields River.

The design specifications call for it to be impassable up to the Q100 (discharge of a flood of the 100-year recurrence interval). The box can carry the Q100, although the two perched by-pass pipes placed within the constructed berm at the Q50 elevation will provide additional relief during high flows.

The barrier will likely be a leap or velocity barrier to all species of salmonids. The current design calls for a 4.2-foot drop from the downstream end of the apron. Typically, leap barriers are based on maximum leaping ability of relatively large rainbow trout, which is about 5 feet. This drop is less than this threshold; however, the hydraulics will present a velocity barrier up to the Q100 with velocities at the end of the apron being approximately 19 feet per second. Increasing the drop would require an additional elevation of the roadbed and a corresponding increase in project costs. Note that brook trout are the primary concern and these fish tend to be small with limited jumping abilities.

Another component of the design specifications is that the barrier is removable. Removal of the concrete walls and barrier using a jackhammer would leave a tall, culvert like structure with a natural streambed beneath. The ability to remove the barrier will allow Yellowstone cutthroat trout conservation actions to proceed downstream should opportunities arise. This reopening of connectivity would allow movement among metapopulations and restore migratory life-history strategies.

Rosgen Level II Characterization and Site Description

Within the project area, the Shields River is a relatively small, montane stream. Its channel morphology differs considerably upstream and downstream of the road crossing. Upstream of bridge, the channel is a B3C channel (Figure 3 and Table 2). Riprap occupies much of the left bank with some of this armoring likely being necessary to protect the bridge. The riprap extends several hundred feet upstream and does not reflect current bank restoration practices. Nonetheless, the stream is slightly entrenched and has access to its floodplain, especially on the right bank.

Figure 3: The Shields River upstream of the bridge and proposed barrier location.

Table 2: Rosgen level 2 classification field data.

Parameter	***Value***	***Description***
Entrenchment	1.4	Moderately entrenched
Width-to-depth ratio	13.3	Moderate to high
Sinuosity	1.2	Moderate
Slope	1.9	
D_{50}	Cobble	
Channel type	B3C	

Downstream of the bridge, the stream varies between an F4 and C3 channel (Figure 4). Immediately downstream of the bridge, the Shields River abuts a steep slope of highly erodible shale. Sediment loading will be reduced with this project, as the new crossing will not direct flows at this crumbling shale slope, as occurs now. Although the stream does have access to a small floodplain near the bridge, the Shields River Loop Road further confines the stream resulting in an entrenched F4 channel (Figure 5). Despite the confinement, the stream has a gentle gradient through this reach.

Figure 4: Immediately downstream of proposed barrier site, showing existing bridge.

Figure 5: Confined F channel downstream of proposed barrier location.

Literature Cited

Endicott, C.L. and 12 other authors. 2013. Yellowstone cutthroat trout conservation strategy for Montana. Report prepared for the Montana Cutthroat Trout Steering Committee.

Kalinowski, S. 2009. Species identification of rainbow and cutthroat trout using diagnostic SNP markers: Results for Horse Creek and Rock Creek. Department of Ecology, Montana State University, Bozeman, Montana.

Kalinowski, S. 2010a. Species identification of rainbow and cutthroat trout using diagnostic SNP markers: Bennett Creek, Crandell Creek, Dugout Creek, Lodge Pole Creek, Mill Creek, Buck Creek, Serrett Creek, and Turkey Creek below culvert. Department of Ecology, Montana State University, Bozeman, Montana.

Shepard B.B., 2013. Jackson Hole One Fly Stream Improvement, interim programmatic report. Report prepared for Jackson Hole One Fly Foundation and the National Fish and Wildlife Foundation. Wildlife Conservation Society, Livingston, Montana.